WRITTEN REPLY

To : Examiner of the Patent Office, Misako ANZAI

1. Identification of the International Application
PCT/JP2005/002560

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4. Date of notification
10/5/2005 (mailing date)

5. Subject matter of reply
On receiving PCT Written Opinion in accordance with Rule 40(2) of the Japanese Law concerning International Applications under the Patent Cooperation Treaty (PCT Rule 43, 2.1), we answer as follows.

(1) The Examiner considers that claims 1 and 13–16 of the present invention are not new over the document 1 (JP 2004-300024) cited in the International Search Report and claims 2, 7, 10, 11 and 23–30 lack inventive step over the document 1. The Examiner also considers that claim 5 lacks inventive step over the document 1 and the document 2 ("Chemical Engineering Handbook", sixth edition, edited by the Society of Chemical Engineers, Japan) and claim 17 lacks inventive step over the

document 1 and the document 3 (F. KAWAMURA et al. "Growth of Transparent, Large Size GaN Single Crystal with Low Dislocations Using Ca-Na Flux System", Jpn. J. Appl. phys., Vol. 42, p.p. L729–L731).

Contrary to the Examiner's decision, the Applicant has clarified the difference between the present invention and the documents 1–3 by the Amendment submitted on the same date as this Written Reply. Therefore, we believe the novelty and inventive step of the present invention should not be denied by the documents 1–3.

(2) Explanation of the present invention

As recited in claim 1 of the Amendment, the present invention relates to "a method for producing a compound single crystal comprising growing a compound single crystal by reacting a source gas with a material solution including other materials, wherein the source gas includes at least one of nitrogen and ammonia, and the other materials include at least one Group III element selected from the group consisting of gallium, aluminum, and indium and a flux material, and wherein a Group III nitride single crystal is grown while stirring the material solution to create a flow from a gas-liquid interface in contact with the source gas toward an inside of the material solution".

One of the technical features in the production method of the present invention is to grow a single crystal while stirring the material solution. By stirring the material solution, it is possible to suppress nonuniform nucleation in the material solution and grow a high-quality single crystal. Moreover, the source gas can be dissolved easily in the material solution, and supersaturation can be achieved in a short time, thus improving the growth rate of the single crystal.

(3) Explanation of the Amendment

In the Amendment, the claims are amended as follows.

The limitations that "the source gas includes at least one of nitrogen and ammonia, and the other materials include at least one Group III element selected from the group consisting of gallium, aluminum, and indium and a flux material" and that "the single crystal is a Group III nitride single crystal" have been added to claim 1. This amendment is supported by claim 13 as originally filed.

Accordingly, claim 13 has been canceled.

With the cancellation of claim 13, claims 14 and 23–25 have been amended to depend from claim 1, and claim 15 has been amended to depend from claim 2.

The remaining claims have not been amended.

(4) Explanation of the cited documents

The document 1 relates to a method for growing a Group III nitride crystal from a melt including an alkali metal. The document 1 discloses that the melt is stirred with a propeller for several hours to mix Ga and Na in the melt.

The document 2 discloses various means for stirring a liquid.

The document 3 relates to a method for growing a Group III nitride crystal from a melt including an alkali metal. The document 3 discloses that a template is placed substantially upright in a crucible.

(5) Comparison of the present invention and the cited documents

The present invention may be the same as the document 1 in teaching the method in which the melt including an alkali metal and a Group III element is stirred, and a Group III nitride crystal is grown in the melt. The present invention may be the same as the document 3 in teaching the method in which a Group III nitride crystal is grown in the melt including an alkali metal and a Group III element.

In the present invention, however, the crystal growth is performed while stirring the material solution. In the document 1, the melt is stirred only for the preparation of a material before starting the crystal growth. Therefore, the present invention is distinguished from the document 1. Moreover, the document 3 does not disclose or suggest stirring the melt and thus differs from the present invention.

In the Written Opinion, the Examiner asserts "the document 1 discloses a method for producing a Group III nitride crystal in which a melt including an alkali metal and a Group III element is stirred with a propeller (impeller), and in a nitrogen (N) containing atmosphere, the crystal is grown in the melt by reacting the Group III element with nitrogen. It is considered that the stirring forms a flow from the gas-liquid interface to the inside of the melt, as described in the paragraph [0081] of the present application".

As indicated by the Examiner, the document 1 discloses stirring the melt with a propeller. However, the stirring is performed to prepare the melt that is to be a material for the crystal growth. Therefore, no crystal is grown at the time of stirring the melt. Thus, the method of the document 1 does not include the process of growing a crystal while stirring the material solution. This is evident from the description in the paragraphs [0047] and [0048] of the document 1 that "(2) Next, the temperature of the electric furnace 30 is raised to 900°C to melt the material in the crucible 36. The propeller 40 is put into the melt 37 and stirs it for several hours so that Ga and Na are mixed in the melt. ... (3) Subsequently, the temperature of the crucible 36 is set to 800°C, and the melt 37 is supersaturated. In this state, the substrate 10 is lowered to the position directly above the melt 37, and the temperature of the substrate 10 is made close to that of the melt 37. After a few minutes, the substrate 10 is inserted into the melt 37 to start crystal growth".

In contrast, one of the technical features of the present invention is to grow a single crystal while stirring the material solution. This is clearly different from the document 1 that allows a crystal to be grown after stirring the material solution. Thus, the document 1 fails to disclose or suggest growing a single crystal while stirring the material solution. Moreover, the document 1 is silent about the superior effects of suppressing nonuniform nucleation in the material solution and providing a high-quality single crystal, obtained by the crystal growth with stirring of the material solution in the present invention.

The documents 2 and 3 also fail to disclose or suggest growing a single crystal while stirring the material solution and the superior effects of the present invention. As described above, the present invention has a distinctive configuration that is not derived from any of the documents 1–3. Therefore, even if these documents are combined, it is not easy for a person skilled in the art to achieve the present invention.

(6) Conclusion

The present invention has a distinctive configuration that is not derived from any of the documents 1–3, and this distinctive configuration can provide particular effects that are not disclosed or suggested in the documents. Accordingly, we believe the novelty and inventive step of the present invention should not be denied by the documents 1–3.